



Collaborative Routing and Coordination Tools (CRCT)

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CRCT Briefing Overview

- **Research and Development (R&D) Background**
- **Capabilities Overview**
- **Status and Next Steps**



CRCT R&D Background

- ***Problem:*** Current process for mitigating weather and airspace congestion related problems is labor intensive and can result in inefficient rerouting
 - Limited information about future state of the National Airspace System (NAS)
 - Limited ability to evaluate potential strategies
 - Limited ability to coordinate potential strategies with airspace users before they are implemented
- ***R&D Objective:*** Provide a Decision Support Tool (DST) that helps select mitigation strategies more effectively and reduces the time required to coordinate those strategies within the FAA and with NAS Users
 - Initial emphasis on rerouting



Development Objectives

- **Establish techniques for improving accuracy of Traffic Flow Management (TFM) trajectory predictions**
- **Develop DSTs and supporting procedures for:**
 - **Quickly determining the need for intervention in developing weather or traffic congestion situations**
 - **Quickly defining reroute strategies for a single or group of aircraft**
 - **Assessing, in real time, the impact of reroute strategies on NAS resources and NAS users**
 - **Facilitating collaboration, within the FAA and between the FAA and NAS users, on reroute strategies**

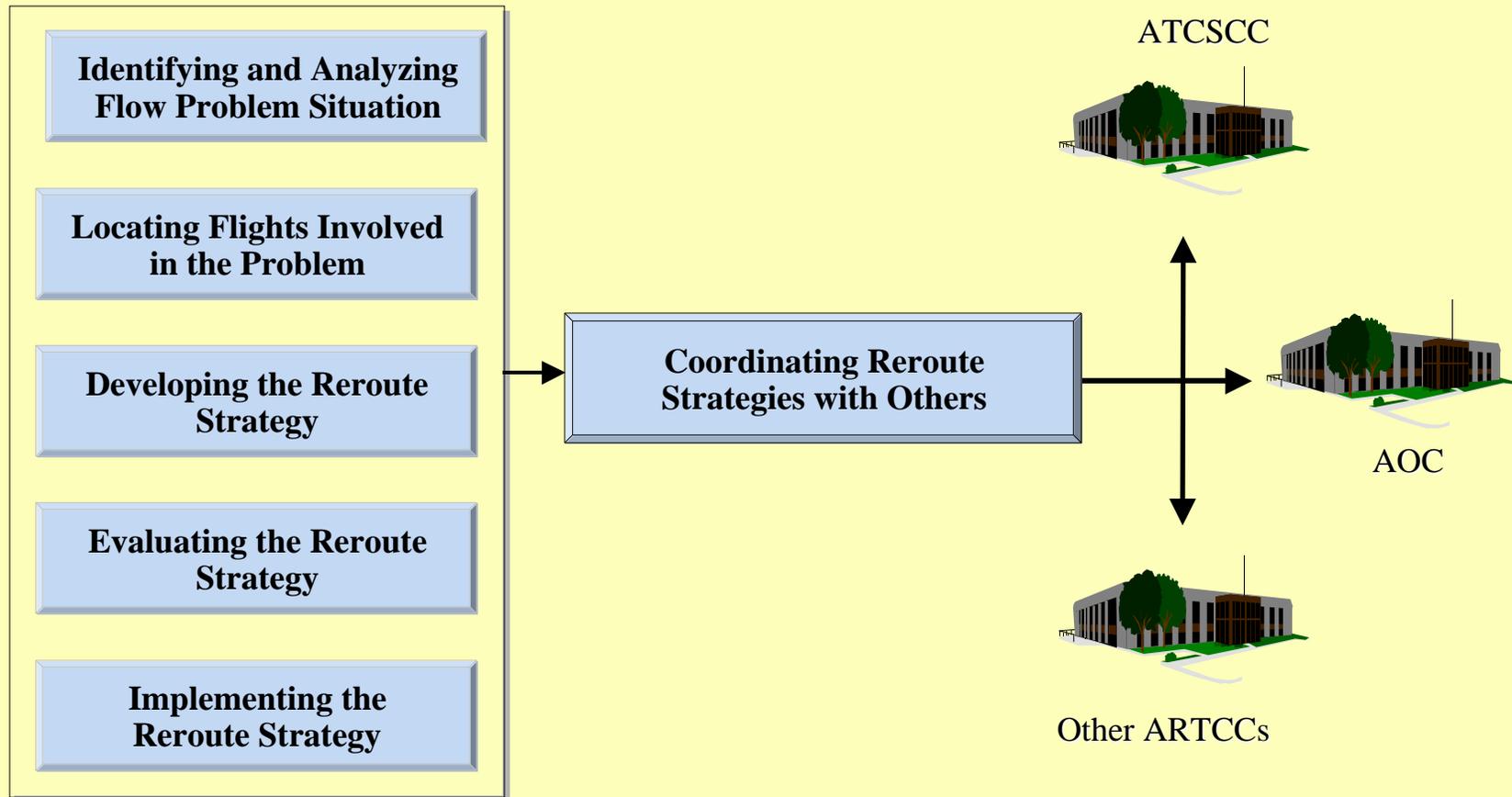


Potential Benefits

- **Improve a flow manager's ability to anticipate flow problem situations requiring reroute action**
- **Allow flow managers to quickly evaluate the impact of reroute plans before they are implemented**
- **Minimize overall impact of reroute strategies on users**
 - **Replace the current system of "blanket" reroutes with aircraft-specific reroutes that may reduce both the total number of aircraft rerouted, and the length of reroutes assigned to individual aircraft**
 - **Provide users with information on how proposed reroute strategies will affect them**



Primary CRCT Capabilities: Overview

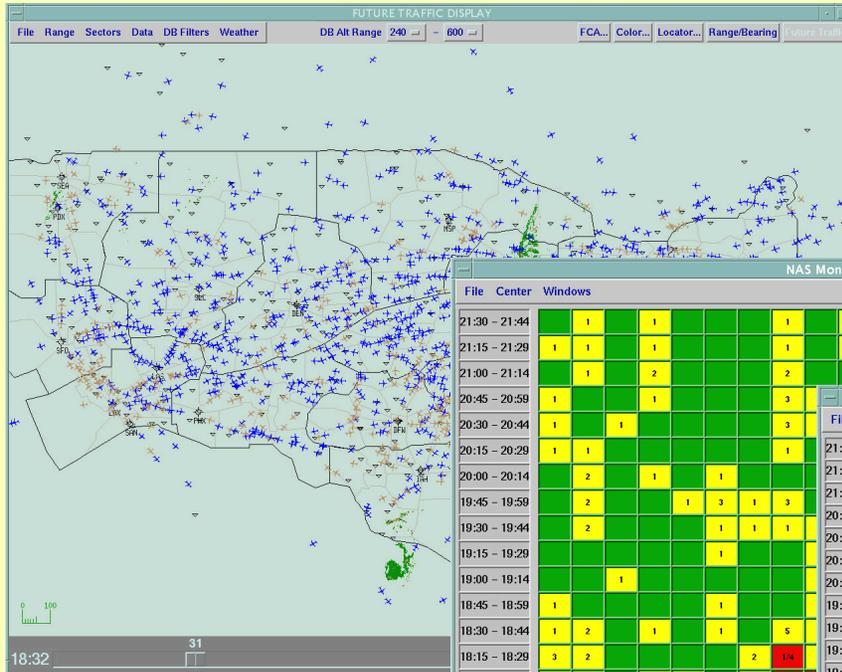


Identifying and Analyzing the Flow Problem Situation

- **Traffic manager can more easily visualize future traffic patterns and flows with Future Situation Display**
- **Traffic manager receives alerts for areas of predicted traffic congestion**
- **Any airspace can be monitored as a flow management constraint (Flow Constrained Area, or FCA)**
- **FCA locations and schedules can be coordinated with other FAA facilities and airspace users**



Identifying and Analyzing the Flow Problem Situation (Concluded)



Future Traffic Display showing weather and traffic 31 minutes from current time

Sector Count Monitor showing predicted counts and alert status for ZOA

NAS Monitor

Last Update: 17:47:00

Time	ZAB	ZAU	ZBW	ZDC	ZDV	ZFW	ZHU	ZID
21:30 - 21:44	1	1	1	1	1			
21:15 - 21:29	1	1	1	1	1			
21:00 - 21:14	1	2			2			
20:45 - 20:59	1	1			3			
20:30 - 20:44	1	1			3			
20:15 - 20:29	1	1			1			
20:00 - 20:14		2	1	1				
19:45 - 19:59		2		1	3	1	3	
19:30 - 19:44		2		1	1	1		
19:15 - 19:29				1				
19:00 - 19:14			1					
18:45 - 18:59	1			1				
18:30 - 18:44	1	2	1	1		5		
18:15 - 18:29	3	2				2	04	
18:00 - 18:14	1	1	3	1		1	29	
17:45 - 17:59	3		1	1	1		31	

NAS Monitor: showing current and predicted alert status for 20 CONUS Centers

ZID

Last Update: 17:47:30

Time	17	18	19	20	21	22	23	24	25	26	30	31	32	33
21:30 - 21:44	3	4	6	5	1	7	3	3	3	4	3	3	3	3
21:15 - 21:29	5	3	2	3	4	1	2	3	2	4	4	2	4	4
21:00 - 21:14	5	3	2	4	3	3	3	3	2	4	4	2	6	5
20:45 - 20:59	7	2	1	3	6	4	2	7	5	6	4	4	7	2
20:30 - 20:44	5	4	1	3	6	4	2	2	4	8	4	3	2	4
20:15 - 20:29	6	3	1	7	3	4	4	4	3	5	3	5	3	3
20:00 - 20:14	3	3	4	7	6	6	7	7	8	4	4	6	6	6
19:45 - 19:59	7	4	6	4	5	3	3	7	5	6	7	4	8	8
19:30 - 19:44	5	3	2	3	5	2	3	3	5	6	5	2	8	7
19:15 - 19:29	1	3	2	3	4	2	3	7	3	3	5	6	7	8
19:00 - 19:14	5	4	1	3	3	3	7	4	4	3	3	3	4	4
18:45 - 18:59	3	6	2	3	3	2	5	7	3	8	4	3	3	3
18:30 - 18:44	3	5	3	4	3	3	4	3	5	10	4	4	7	7
18:15 - 18:29	2	3	3	3	3	3	3	3	3	3	4	4	4	4
18:00 - 18:14	4	3	7	17	9	4	4	3	3	14	5	4	8	8
17:45 - 17:59	4	2	2	19	6	7	3	7	3	16	8	3	3	3

Aircraft Time in Sector display for ZOA Sector 32

Time in Sector * ZOA * Sector 32 * 15:15 - 15:29

Aircraft Count: 47 Sector: 32 Threshold: 15

TIME	20	18	18	18	17	16	14	14	15	16	14	13	14
AS4422 (ZOH)													
QAE2415 (ZOH)													
RA1108 (ZOH)													
AS4407 (ZOH)													
RA1182 (ZOH)													
NAH1556 (ZOH)													
CD4541 (ZOH)													
AS4500 (ZOH)													
AS4557 (ZOH)													
URL2800 (ZOH)													
UPS2945 (ZOH)													
FDX3232 (ZOH)													
DAL126 (ZOH)													
US470 (ZOH)													
AS497 (ZOH)													
URL38 (ZOH)													
AS421 (ZOH)													
NS1MB (ZOH)													
URL2374 (ZOH)													
RA1636 (ZLD)													



Locating Flights Involved in the Problem

- **Rapidly identifies aircraft predicted to operate through an identified constraint (FCA)**
- **Aircraft may be exempted from the FCA (ex., all aircraft landing at ORD airport)**
- **List of affected aircraft can be coordinated with**
 - **Airspace users**
 - **Other FAA facilities**



Locating Flights Involved in the Problem

(Concluded)

Traffic display showing FCA and affected routes

FCA list showing aircraft associated with FCA

FCA DEFINITION

File

FCAs

FCA ID: FCA1

Center

Start Time: 11815

End Time: 2015

Apply times: within airspace

Ceiling: []

Floor: []

Speed: []

Heading: []

FCA drawn at start time position

Identify flights that match **all** of the following:

do depart from []

do arrive at []

do use route/fix []

are located in []

active/inactive: active inactive

NRP: NRP not NRP

operation types: Air Carrier GA

do have TAS: greater than [] 3000

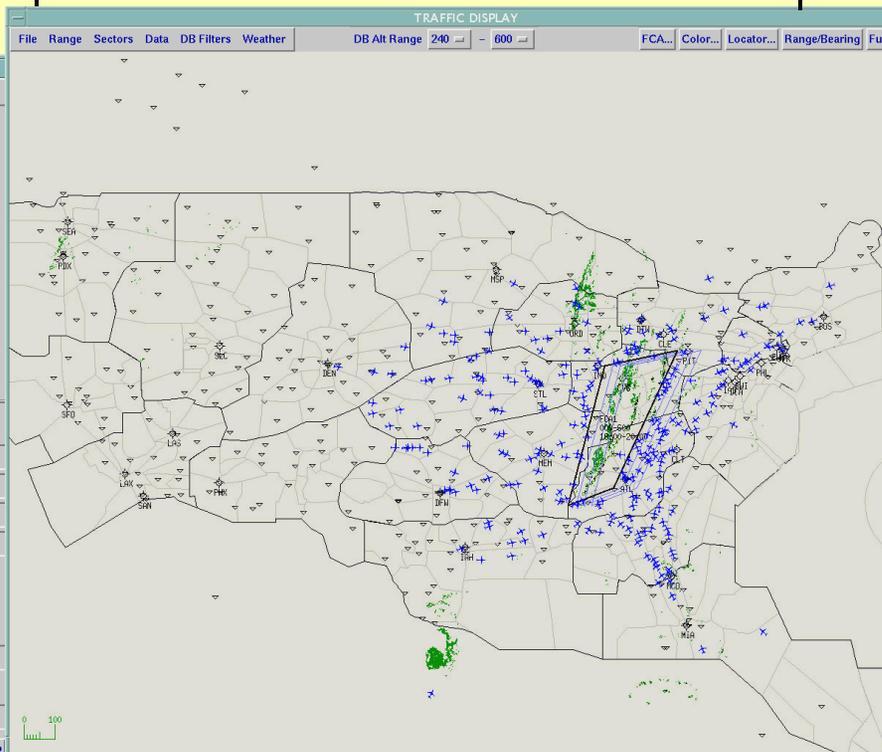
do have heading: +/- [] 145

do have ACID that contains []

Expand Conditions Collapse Conditions Clear Group New Group

Suppress these flights: []

Apply New Delete FCA Remove Filters Close



FCA LIST

File Sort Show Windows Active: 227 Inactive: 218 = 445

N1592G	(ZAU)	FCA2	0:09:29
C421A	100	DAL-GRABE.4225/08753-UGN	
AAL1463	(ZAU)	FCA2	0:09:29
T/F100/E	095	EWR-FNT.PMM4-ORD	
GLA6683	(ZAU)	FCA2	0:09:29
T/B190/A	122	ORD-PLL-DBQ	
N421MP	(ZAU)	FCA2	0:09:29
C421G	007	MWC-BRAVE-DAY	
N68BC	(ZAU)	FCA2	0:09:29
FA20G	007	ENW-GREAS.4224N/09623W-SUX	
UAL945	(ZAU)	FCA2	0:09:29
H/B772/W	162	EDDF-TVC.PMM4-ORD	
N889DM	(ZAU)	FCA2	0:09:29
C414G	040	CGX-UES	
UAL1041	(ZAU)	FCA2	0:09:29
T/B735/F	045	DFW-BAYLI.BDF3-ORD	
BLR847	(ZAU)	FCA2	0:09:29
T/GAR/JF	088	ORD-BDF-PIA	
COA1297	(ZAU)	FCA2	0:09:29
T/B735/E	031	EWR-GSH.GSH3-MDW	
N9VF	(ZAU)	FCA2	0:09:29
C550G	301	GRB-FLM.HENBY-GSO	
TWA840	(ZAU)	FCA2	0:09:29
B/B762/E	370	LAX-J94.OBK.SYM-JFK	NRP
N435T	(ZAU)	FCA2	0:09:29
T/F2TH/I	006	MDW-GIJ.J554.CRL-TEB	
AAL419	(ZAU)	FCA2	0:09:29
T/MD80/A	036	BDL-PMM.PMM4-ORD	
AMT534	(ZAU)	FCA2	0:09:29
T/B72Q/I	015	RSW-BVT.BVT2-MDW	
AWI620	(ZAU)	FCA2	0:09:29
T/B446/F	070	ORD-PETTY-MKE	
N419WC	(ZAU)	FCA2	0:09:29
FA10I	246	MWC-SQUIB.PMM.3939/07833-BOS	
VVJU628	(ZAU)	FCA2	0:09:29
T/D39/R	310	NGU-FWA.OBK.J90-NFL	
N15RH	(ZAU)	FCA2	0:09:29
LJ35G	266	RAC-OBK.J84.WORDY-IND	
RYN733	(C93)	FCA2	0:09:29
B72Q/A	000	SEA-MCW.JV14-ORD	
N5732	(ZAU)	FCA2	0:09:29
FA50I	370	PDX-ECK.JHW.J70-TEB	
SAB539	(ZAU)	FCA2	0:09:29
H/B743/W	071	EBBR-TVC.PMM4-ORD	

FCA definition window to define FCA and appropriate filters

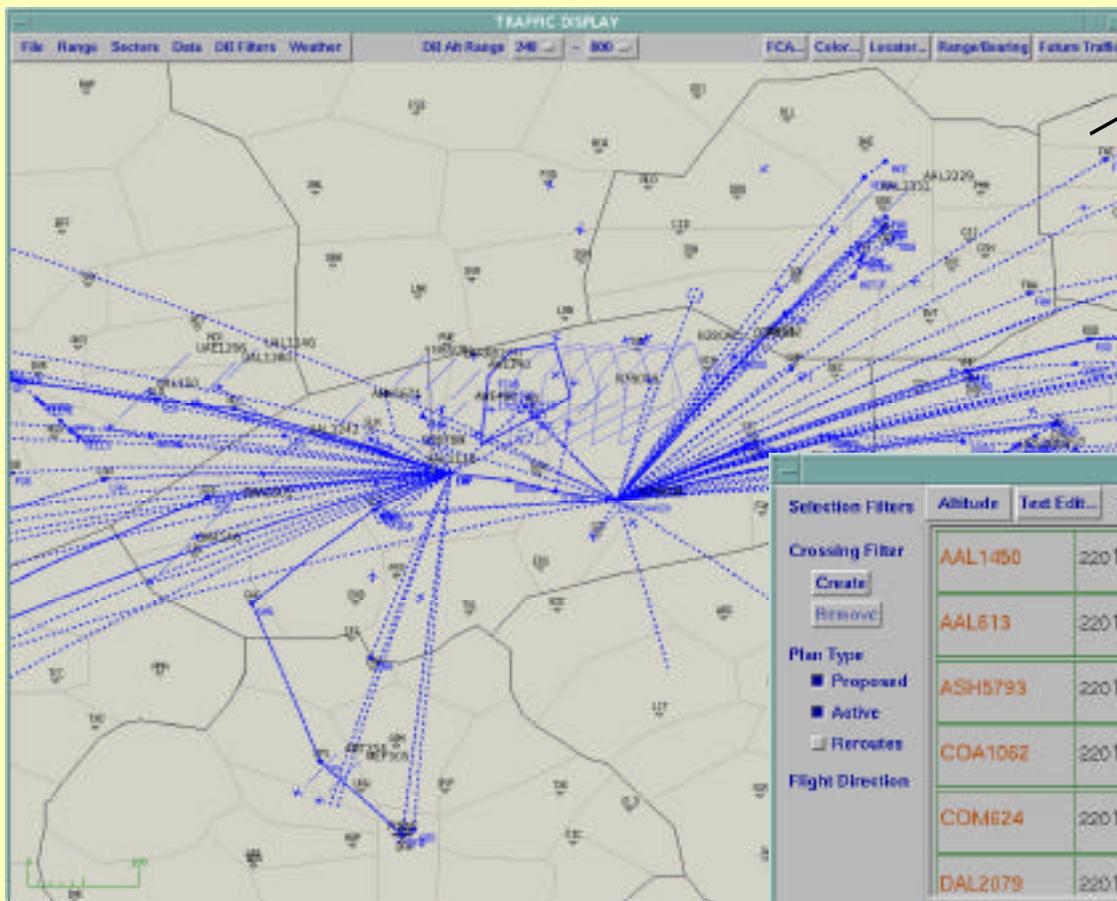


Developing the Reroute Strategy

- **Traffic manager can rapidly define aircraft reroutes**
 - Individual aircraft
 - Groups of aircraft
- **Proposed reroutes can be coordinated with**
 - Airspace users
 - Other FAA facilities



Developing the Reroute Strategy (Concluded)



Traffic display
showing group
reroute definition

Rerouting window
showing reroutes
for selected
aircraft

REROUTING - Set 3

Selection Filters: Altitude Text Edit Avg: -00:07+0.0nm Total: -12:26+0.5nm 103 of 103

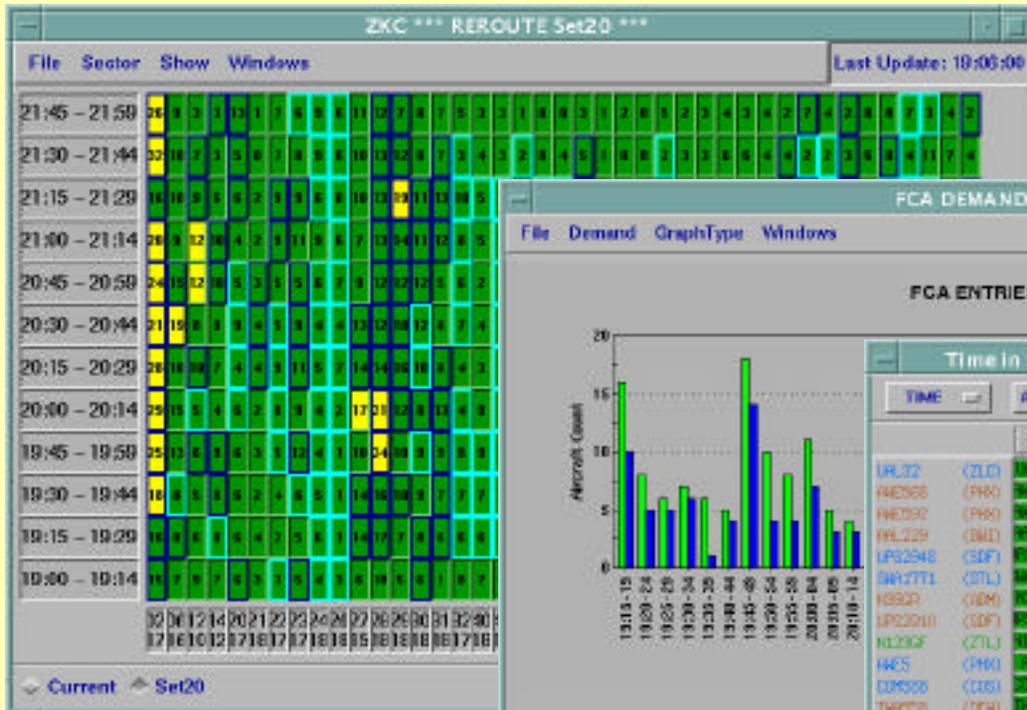
Crossing Filter	Altitude	Text Edit	Avg	Total
<input type="button" value="Create"/> <input type="button" value="Remove"/>	AAL1450	220T 000	STL CARD56 CAPPNT PLAND ORD	-00:02 0.0nm
	AAL613	220T 000	STL LINDYE MAP RZC PSMOPW	-01:58 0.0nm
Plan Type	ASH5793	220T 000	STL GATWY4 CREEP APE JST BUNTSI PHL	+03:21 0.0nm
<input checked="" type="checkbox"/> Proposed	COA1062	220T 000	STL BLUE32 BJ J123 BGV J42 HOL PAK R/C J14 PXT RGV1 EVR	+01:37 0.0nm
<input checked="" type="checkbox"/> Active	COM624	220T 000	STL BLUE32 ENL MOSEYS CVG	-00:42 0.0nm
<input type="checkbox"/> Reroutes	DAL2079	220T 000	STL PLE531 ENA RMQ2 ATL	-01:07 0.0nm
Flight Direction				

Evaluating the Reroute Strategy

- **Traffic manager can evaluate effect of proposed reroutes on sector counts or other measures of traffic congestion**
- **Other facilities can examine the effects of the proposed reroutes on their Center/sectors**
- **Traffic manager can examine future traffic flows using proposed reroutes**
- **Traffic manager can compare predicted effects for alternative strategies**



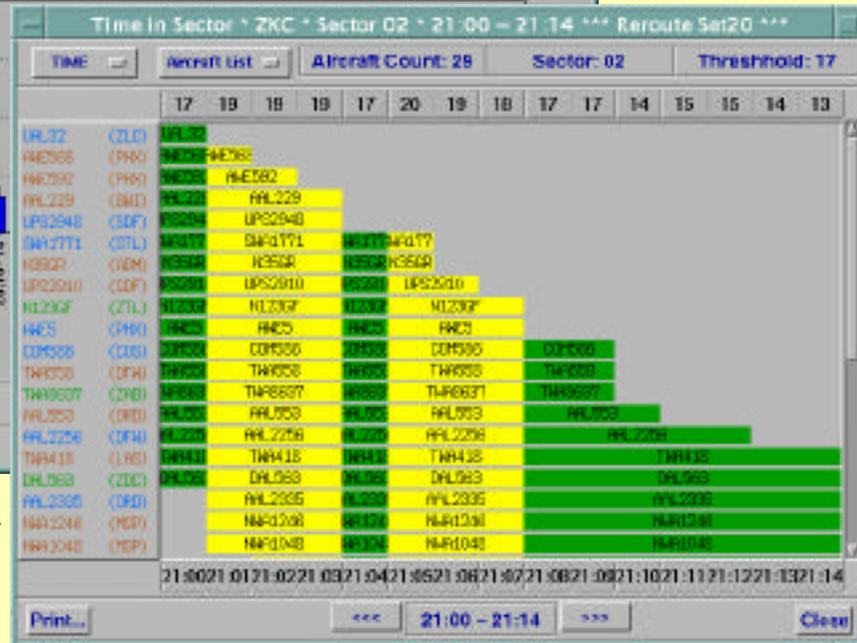
Evaluating the Reroute Strategy (Concluded)



Predicted sector counts for aircraft on reroutes



FCA entry times based on reroutes



Aircraft sector transit times showing changes caused by reroutes



Coordinating and Implementing the Reroute Strategy

- **Web-based capability developed for initial collaboration on reroute strategies**

The screenshot shows a web-based interface titled "Capture Event". It features several input fields and buttons. The "Event Name" field contains "ZID Wx". Below it, the "Event List" shows "ZID Wx [Recorded on 05/18/99 at 18:09:47]". There are three main selection sections: "CHOOSE FCA(s)" with "FCA1" selected, "CHOOSE SET(s)" with "Set3" selected, and "CHOOSE DISPLAY(s)" with checkboxes for "Traffic Display", "Rerouting List", "FCA List", "FCA Demand Graph", "FCA Definition", and "NAS Monitor". To the right of these is a "Sector Count Monitor" section with a list of airports: ZFW, ZHN, ZHU, ZID (highlighted), and ZTX. There are "Clear All" and "Set All" buttons next to this list. At the bottom of the interface are buttons for "Post Event", "Update Event", "Delete Event", "Delete All Events", "Reset", "Save Data Only", and "Cancel".

- **Electronic means for sharing data and reroute strategies being investigated**
 - Within ARTCC
 - Other ARTCCs
 - ATCSCC
 - Users

Status and Next Steps

- **Conducting limited demonstrations and field evaluations**
 - ZKC field lab and TMU
 - ATCSCC A-lab and Operations floor
 - ZID training room and TMU
- **Transitioning initial R&D results to FAA**
 - Working with AUA-700 on Collaborative Routing Implementation Plan
 - Working with Volpe Center to incorporate results of CRCT FCA and trajectory modeling R&D into ETMS
- **Doing R&D on “end state” concept**
 - Integrated Impact Assessment (Reroute, MIT, Schedule)
 - Automating FCA and reroute capabilities



Support Slides



CRCT Functional Architecture

